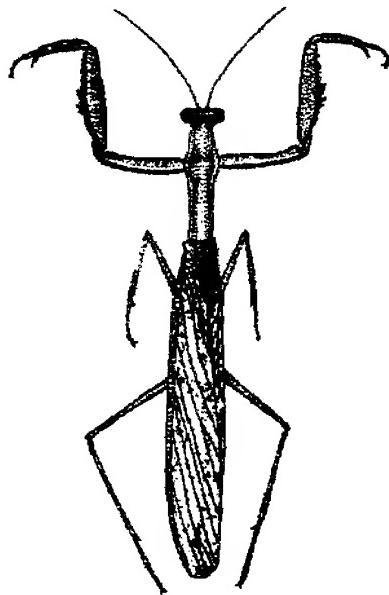


Mantis Study Group Newsletter 7

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Newsletter Editor
Phil Bragg
51 Longfield Lane
Ilkeston
Derbyshire
DE7 4DX

Membership Secretary
Paul Taylor
24 Forge Road
Shustoke
Coleshill
Birmingham B46 2AU



Editorial

We apologise for the late arrival of the last newsletter. As many of you will know, Kieren Pitts prints and posts the newsletters for me: apparently his landlady went mad (in the clinical sense, rather than a way of saying she was in a bad mood) so Kieren had to move house at very short notice. Naturally the disruption to his domestic life delayed the printing and posting of the newsletter. I have told Kieren to stop putting LSD in his landlady's tea so hopefully the newsletters will be on time in future! Kieren's new address is: Top floor flat, 6 Woodland Road, Bristol, BS8 1TN.

If this newsletter looks thin it is because only two people have written something. A poor response to my request for items from the other 197 of you!

There is some further information on page 6 about the MSG meeting in May.

Kettering Insect Fair

For future reference: the venue is just off junction 8 of the A14. The next exhibition is on March 22nd, from 1030-1630. The MSG will be exhibiting.

This new venue, for what was previously the Leicester Insect Fair, is very smart: larger, cleaner, easier to get to than the old venue, and plenty of parking space for exhibitors. For the December exhibition, the first at Kettering, there were less visitors than usual: inevitable for a new venue since the local population would be relatively unaware of it; some people may have been put off by not knowing how to find either Kettering or the Leisure Village! For those that have not been to this or the Leicester Fairs, it is one of the "Big Three" insect trade exhibitions in Britain (two at Kettering, in March and December, and the AES exhibition at Kempton Park in October); it is attended by most of the major dealers in insects (live and dead), entomological equipment and books.

Notes on the species of *Popa* in culture — Phil Bragg.

The species in culture appears to be *Popa batesi*. This species is very similar to *P. undata* (and may have been synonymised with it). *P. batesi* is from Madagascar, *P. undata* is from mainland Africa. They may be distinguished by the following:

P. undata: Male with a lobe on the hind tibia. Female with two lobes on hind tibia (one near the middle and one near the end).

P. batesi: Male without lobe on hind tibia. Female with only one lobe on the hind tibia (near the middle of the tibia).

Australian mantis in culture. — Phil Bragg.

At the AES exhibition in October 1997 Paul Taylor and I were given some first instar nymphs of an unidentified mantis from Australia by Mark Bushell. I have since checked back with Mark who has told me the original ootheca was collected by Barry Clark at Kuranda, Queensland (i.e. about 15 miles N of Cairns). So far my nymphs are doing well. It will not be possible to identify them until I have dead adults but I am putting this note in the *Newsletter* so that anyone else who has them from the same source will know where they originated!

Nervous Disposition? — Steven Boutcher.

On the 8th of December 1997 I was trying to move my large adult female *Deroplatys desiccata* from her sweet jar cage into a much larger fish tank. I was doing this with the intention of trying and pair her with an adult male later that evening. I had managed to get her out of the jar whilst she was still sitting on her twig, so I decided to stroke her wing to see how she would react. Bad mistake. She immediately leapt off the twig and ran extremely quickly across the top of my desk. She did not stop at the edge either, she just ran straight off it and fell about 60cm to the floor. Obviously concerned, I checked to see if she was okay. Everything was fine. As I moved my hand towards her to pick her up, she turned right around to face me. In a flash she spread out her wings to reveal startling black, red and white eye spots, one on each wing. She then commenced swaying her upper body to-and-fro quite violently. I had to wait about ten minutes before she was calm enough to be placed into the tank.

Such "jumpy" behaviour does not seem to be common place amongst most species of mantis. *Sphodromantis lineola* for example will almost always let you stroke its abdomen and pick it up without any problems. Sometimes *S. lineola* will turn around to inspect the intruder who is so rudely stroking her, but that is all. I have never had a *Sphodromantis* species which is nervous. *Tenodera sinensis* and *Polyspilota aeruginosa* also seem to be quite passive.

***Sphodromantis lineola* — Steven Boutcher.**

Sphodromantis lineola is a commonly kept mantis and is widely available throughout the UK. Many mantis enthusiasts keep this species in culture year after year, mainly because of its ease of breeding and rearing. This is a medium sized mantis which originates from Africa. Adult females reach a length of about 70mm. Males also grow to about 70mm and can occasionally be longer than the female. However, males are always much slimmer and far less heavily built than their stocky counterparts. Colouration is usually vivid or pale green, through to grey or light brown. This is one of many species where colour is clearly affected by the level of humidity. High humidity often produces green or greyish specimens, whilst dry conditions more often produce brown specimens.

S. lineola is fairly placid and is usually easy to handle, i.e. they do not normally dash away from an intruding entomologist's hand. They have proven themselves to be quite hardy, and rarely die unexpectedly. Males are fairly good fliers and have an annoying, yet predictable, habit of taking flight whenever they reach the top of a plant or twig. As well as being competent aviators, males can jump very accurately over an impressive distance. I can recall taking a male *S. lineola* out of his cage with the intention of taking some

photographs of him eating a cricket. I carefully set him on a plant and offered him a cricket in a pair of tweezers. He gladly accepted the food and began munching away happily. After taking a few shots of him, he became anxious and suddenly decided to leap about 20cm onto my tightly closed mouth and, would you believe it, he was still carrying his cricket in his forelegs and continued to eat his prize without a care in the world.

The females of are particularly stocky and become extremely fat, almost to bursting point before they lay an ootheca. It is quite incredible the amount of food they can pack into their stomachs. Females have colossal appetites and will eat just about every time they are offered food. Males on the other hand eat considerably less and will not usually take prey much larger than medium sized crickets. Females can tackle large insects, even as large as themselves. Adult locusts are no problem and are eaten with relative ease. If a locust does put up a fight then *S. lineola* often makes the somewhat intelligent decision to bite off, or consume the hind legs first. The loss of the rear legs almost totally incapacitates the locust. In addition to crickets and locusts, *S. lineola* will also take large moths and flies. In fact it seems quite clear that this species of mantis prefers prey that crawls, rather than flies. If a fly just happens to buzz past a hungry individual then *S. lineola* will make a half hearted attempt at snatching it from the air. Fortunately for the fly, this species of mantis seems to be unable to catch fast flying insects in mid air. Most of the time it will lash out slightly too late, often making contact with the fly causing it to be knocked off course, but rarely actually snaring the fly in a secure grip. Extremely fast reflexes are required to catch a fast flying insect in mid air, an ability which seems to be best demonstrated by members of the *Hymenopidae*.

None of the *Sphodromantis* species seem to be particularly active. I have known several occasions when the mantis has sat on its perch for days on end, only moving briefly to wash and clean its feet and antennae. However during warm weather males of *S. lineola* can become extremely active and may frantically try to escape from their cage. This behaviour is because the male is following his natural instincts to roam around in search of a mate. Sometimes males can become extremely aggressive and will frequently show their threat displays for no apparent reason. Despite this behaviour, *S. lineola* seems perfectly happy housed in quite a small cage, e.g. a sweet jar 30cm tall and 12cm in diameter

Like all mantids, *S. lineola* reacts to danger in a specific way: females will turn their forelegs outwards to reveal bright yellow and black markings [These are often absent — Editor]. The intention of the display is to startle a potential predator by this unexpected sudden flash of colour. Adult mantids may also open up and spread out their wings giving a passable appearance of greater size. Males seem to be far less confident in facing an adversary too large to eat. Initially they will turn out their forelegs in the same way as the females. If this fails to ward off a predator a frightened male will turn and run away extremely quickly. He may even take flight in order to escape.

When *S. lineola* is in the nymphal stage of its life it carries the abdomen over its thorax. This characteristic is common amongst several mantis species. Kept at 23-28°C nymphs will moult every 12-18 days. Although when a nymph is sub-adult it may take inevitably longer than 18 days to moult. As with most species, small *S. lineola* nymphs feed well on fruit flies or very small crickets.

Breeding *S. lineola* is usually quite straight forward and without to many problems. As per normal ensure that the female is extremely well fed. If the male that you will be using is normally kept in a fairly small cage you should transfer him to a cage about 45cm long, 30cm tall and 30cm deep or bigger. Furnish the cage with plenty of twigs or branches.

This will give the male sufficient cover should he need to hide from the female. Finally the female should be introduced to the male's cage. Introducing the female into the male's cage has the distinct advantage that the male will normally spot her before she does him. If the male is aware of the female's presence, he will not accidentally wander into her path and end up as lunch. All that is left to do now, is leave them together and hope for the best. If the female mantis is receptive she may give off a special pheromone intended to attract a mate (although I am not certain of this). Mating often occurs under the cover of darkness as the male's movements are less likely to be noticed by the female. If the male is lucky he may be able to simply sneak up behind the female and leap straight onto her back. Sometimes she will see the male approaching from behind and will try to catch him. If this does happen, the male will almost certainly be eaten. In some situations the male mantis will perform a rather bizarre courtship display. I have never seen a male *S. lineola* perform a display, but I have heard it may last an hour or more. Once the mating position has been established, they may stay together for up to 24 hours, although from my experience mating rarely exceeds more than 12 hours. In a minority of cases the male will sit on the female's back, but not actually mate. They seem to forget sometimes, why they are there and what they are supposed to be doing. Once mating is over, the male will jump off the female's back and make a speedy exit. This is, of course, assuming that he is still alive. As long as the female has been fed as much as she will eat, the chances of her decapitating the male whilst mating are quite low.

In general, *Sphodromantis lineola* has proven to be a very pleasant and easy species to rear. That's probably why it is frequently recommended for beginners. The life span of *S. lineola* varies from about 7 months to about a year.

Theory on the partial loss of limbs in mantids - Steven Boutcher.

For the November 1997 edition of the MSG Newsletter I wrote an article concerning mantids deliberately biting off parts of their own legs and antennae. Upon receiving the November newsletter I read Phil Bragg's article which suggested that apparent self mutilation in mantids could in fact be quite accidental, and caused by carelessness and old age. I agree that old age may well have some influence on the mantids loss of tarsi/tibiae. However, I now suspect that this defect is in fact a nutritional problem. A mantis in its natural habitat would feed on a reasonable variety of invertebrate prey, butterflies, moths, beetles, phasmids, spiders and caterpillars are just a few examples of a mantis's natural prey. Therefore the mantis would receive sufficient nutrition, and so maintaining healthy limbs and body. In captivity most rearers are likely to feed their mantids only one or two different types of food e.g. crickets or maggots. It seems reasonable to assume that such a lack of variety can lead to a type of insect malnutrition, which in turn could lead to the degeneration and the weakening of limbs. Many predacious invertebrates feed on a variety of prey, the tarantula for example may feed on locusts, katydids, small vertebrates beetles and so on. Well, there you go, that is my theory on why mantids lose parts of their legs. If any other members have alternative explanations I would be very interested to hear them.

Coming in on a wing and an ear: how mantids use their hearing — David Yager.

In some respects, the previous articles on mantis hearing have raised many more questions than they have answered. The most tantalizing of these have to do with mantis behaviour in the wild. We have one-eared mantids, two-eared mantids, and no-eared mantids (some that never had an auditory system and others that had one, but then lost it). What sense can we make of all this in terms of mantis behaviour? How do mantids use their ears, anyway?

We can start by asking if hearing is used for intraspecific or for interspecific communication. The former is ostensibly easy to deal with since no mantis is known to produce sounds in any social context (A number of species produce defensive sounds to startle predators, but that is an interspecies interaction.). This is a bit of a surprise since soothing signals from a small, timid male to a large, voracious female would seem to be wise. On the other hand, in the highly dimorphic species where such signals would be particularly advantageous, the females are deaf, so it is a moot (mute? ...) point. In short, I do not know of any evidence to support the idea that mantids are "talking" to one another. Nonetheless, we will revisit this possibility later.

Using a broad definition of communication, animals of different species sometimes communicate acoustically. In a few cases, this is intentional and mutually beneficial (you and your dog, for instance), but the result is more commonly less symmetrical and much less benign. One animal may eavesdrop on a pack of hunting predators and thus avoid being eaten. A parasitoid may use the mating calls of its host as a navigational beacon. A predatory female may lure males of another species to their death by mimicking the other females' love song.

Mantids listen to ultrasound, and the major biological source of ultrasound in any environment is hunting bats. These nocturnal, flying predators navigate and locate their victims using very sophisticated sonar: they broadcast ultrasonic pulses and the returning echoes let them locate and evaluate potential prey items. The majority of bats use sonar pulses in the 30-50kHz range, exactly the frequencies to which mantids are most attuned. Putting these observations together, we hypothesized that mantis hearing provides an "early warning system" that helps them evade captures by hunting bats, i.e. interspecific communication.

Flying mantids respond dramatically to bat-like ultrasound. This is easy to demonstrate: glue or wax a thin, stiff wire or stick to the posterior pronotum of a long-winged male mantis (in general, smaller species fly better than larger species); hang the mantis up in the air and have a gentle wind blowing on its head: it will, quite sensibly, start flying; loudly jangle a set of keys near the animal (this produces lots of ultrasound). Flying mantids respond very quickly: the response is complete in less than 0.15 seconds; the arms actually start moving after about 0.05 seconds. They completely extend their forelegs, roll their head to the side, and curl their abdomen up (one popular press reporter called this the "superman posture"). There are also important changes in the wing beat frequency and wing stroke angles, but these are more difficult to observe directly. A mantis that is not flying does absolutely nothing in response to ultrasound, even though it hears the stimulus perfectly well.

We employed strobe photography to record the changes in flight path that the ultrasound-triggered behaviour causes in unrestrained mantids. Using arguments derived from Hegel and Kant, we first convinced a male mantis to fly in a perfectly straight line along the focal plane of a camera 1-15 meters away (try it sometime ...). A strobe with flashes at intervals of 0.02 second provided illumination. When the males entered the frame of the

camera, we played simulated bat sonar pulses. The resulting photos showed flight paths populated with ghostly images of the mantis: and they taught us a great deal. For instance, our males (these were *Paraphendale agrionina*) could detect and respond to the "bat" when it was 10 meters away. This is very good news for the mantis since bats can detect prey only when it is within about five meters. The responses were gentle turns when the bat was distant, but increased in intensity and complexity as the distance between predator and prey decreased. A moderately strong response typically comprised a sharp turn combined with a shallow dive. Loud ultrasound triggers the most dramatic evasive behaviours: steep, spiralling power dives. *P. agrionina* normally flies at a little less than 2ms^{-1} (4.4 mph), but their speed often increased to over 4ms^{-1} in the evasive dive.

Of course, the really important question is whether or not these aerial manoeuvres actually help the mantis when faced with a hungry bat. They quite decidedly do. With the generous help of some bat researchers, we flew mantids outdoors in the same flight space bats were using to hunt (we worked in a dimly lit parking lot at a Canadian provincial park campground). When a mantis deaf to the bats was attacked, it made no evasion attempt and was captured in over 80% of the trials. These trials were emotionally trying to watch: we could actually hear the "thunk" when bat hit the mantis. On the other hand, males that could hear the bats and that performed evasive manoeuvres escaped capture in all cases. They most commonly used steep dives. The dive sometimes ended with the mantis on the ground, but other times the males levelled off and flew away, skimming along just above the ground. (By the way, there are very interesting parallels between mantis flight strategies and those used by fighter pilots in dog fights.)

Almost all mantids that fly and hear ultrasound show similar ultrasound-triggered behaviours, so we feel quite confident that bat evasion is a major function of hearing in the suborder. That does not, however, mean it is the only function. For instance, I am mightily embarrassed that even after several years of trying, we do not as yet have a clue how hymenopodines use their low frequency hearing: except it clearly is not related to predator evasion. The argument that some mantids may "talk" to each other during courtship remains very attractive, and I suspect we have not detected it simply because we do not know how or when to listen. Growing evidence suggests that a number of species confine their romantic activities to a very narrow time window each day: a half hour just before dawn, an hour in the late evening, 20 minutes two hours after sunset. It will take careful and very thorough natural history observations to sort all this out. The message is clear: we are just beginning to explore the auditory world of the mantis.

1998 Mantis Study Group Meeting — Phil Bragg.

This is being held in conjunction with the British Tarantula Society (BTS) Show is being held on 17th May 1998 at Wood Green High School, Wednesbury, West Midlands. We have a room booked so we can hold our own private meeting at some stage during the day; at present the time has not been fixed. The BTS show opens at 1030, there is a small admission charge. The show is attended by many of the livestock dealers (both insects and spiders). I will probably bring my mantis cabinet (containing about 65 species) along for the MSG meeting. There will also be a slide show of Bornean mantids at some stage during the day; this will be open to everyone, not just MSG members (Making the slide show open to anyone enabled us to book the private room free of charge).

For further details wait for the May Newsletter (which will hopefully be out in early May) or contact Paul Taylor or myself.

Mantis abstracts

The following are abstracts from papers published recently. The papers are in English unless otherwise indicated. The editor would be grateful for copies of any recently published papers so that abstracts may be included in this section of the newsletters.

Chase, M.R., Bennett, R.R. & White, R.H. (1997) Three opsin-encoding cDNAs from the compound eye of *Manduca sexta*. *Journal of Experimental Biology*, 200(18): 2469-2478.

Three distinct opsin-encoding cDNAs, designated MANOP1, MANOP2 and MANOP3, were isolated from the retina of the sphingid moth *Manduca sexta*. MANOP1 codes for a protein with 377 amino acid residues. It is similar in sequence to members of a phylogenetic group of long-wavelength-sensitive arthropod photopigments, most closely resembling the opsins of ants, a praying mantis, a locust and the honeybee. MANOP2 and MANOP3 opsins have 377 and 384 residues respectively. They belong to a related group of insect visual pigments that include the ultraviolet-sensitive rhodopsins of flies as well as other insect rhodopsins that are also thought to absorb at short wavelengths. The retina of *Manduca sexta* contains three rhodopsins, P520, P450 and P357, with absorbance peaks, respectively, at green, blue and ultraviolet wavelengths. There is evidence that MANOP1 encodes the opsin of P520. We suggest that MANOP2 encodes P357 and that MANOP3, representing a class of blue-sensitive insect photopigments, encodes P450.

Klass K.D. (1997) The external male genitalia and the phylogeny of Blattaria and Mantodea. *Bonner Zoologische Monographien*, 42: 1-341.

The external male genitalia of Blattaria and Mantodea (phallomeres, phallomere complex) are highly complicated structures, which are always extremely asymmetrical. They are provided with many sclerites and muscles. Their cuticular surface is complexly folded, and there are many distinct invaginations and evaginations (the formative elements), which may have the shape of spines, lobes, bulges, pouches, apodemes, tendons, etc.. The knowledge of phallomere morphology is extremely incomplete, and the potential for phylogenetic research inherent in these structures has so far hardly been used. In 4 species of Mantodea and 10 species of Blattaria the sclerites, muscles, and formative elements of the phallomere complex and some other parts of the male postabdomen have been investigated in detail. Most of the subgroups of Blattaria (subfamilies in the system of McKittrick, 1964) and four families of Mantodea (of the system of Beier, 1968) are represented in this sample. Certain parts of the phallomeres are described for some further species of Blattaria. A detailed homology hypothesis is presented for the sclerites, muscles, and formative elements of the phallomeres, which includes the homologies between Blattaria and Mantodea. The common ground-plan of Blattaria and Mantodea has been reconstructed. Phallomere characters have been evaluated in terms of phylogeny. The resulting phylogenetic hypothesis is roughly as follows: In Mantodea, the basal dichotomy is between Mantoididae and the other families; the second one is between Chaeteessidae and the remaining families. In Blattaria, the basal dichotomy is between Blattinae + Potyzostrinae and the remainder. These remaining Blattaria can be divided into three groups: The first consists of Tryonicinae only. The second contains Cryptocercidae as well as Lamproblattinae and Potyphaginae, the two latter taxa being especially closely related. The third group comprises Blattellidae and Blaberidae. Blattellidae are clearly paraphyletic, with Blaberidae as a rather subordinate subgroup. The first offshoot within Blattellidae (+ Blaberidae) are the Anaplectinae. The

subsequent offshoots are various species of Plectopterinae, which is a paraphyletic taxon, too. Blaberidae, Nyctiborinae, Blattellinae and Ectobiinae together form a holophyletic group. Nyctiborinae and Blaberidae are possibly sister-groups. Some other important results are: (1) The asymmetry of the phallomere complex is homologous in Blattaria and Mantodea, and the morphology of each side is quite similar in the two groups. In Mantodea the hook-process hla (sclerite L3 of McKittrick, 1964) is missing; this might be the consequence of a derived copulation procedure. (2) In the common ground-plan of Blattaria and Mantodea asymmetry is already as extreme as in the extant species. The opinion of Mizukubo & Hirashima (1987) that the stem-species of Blattaria still had symmetrical phallomeres is refuted. (3) The ground-plan morphology is most extensively retained in the Mantodea Mantoididae (left side) and Chaeteessidae (right side). In Blattaria, Blattinae have retained many ground-plan features, but in some other phallomere characters they are rather derived. The phallomeres of Cryptocercidae are not close to the Blattarian ground-plan as it is the opinion of McKittrick (1964). (4) The hypothesis of Bohn (1987) that the side-reversed similarities of the phallomeres of Blaberidae on the one hand and of some subgroups of Blattellidae on the other are due to homology is highly supported. They are not due to parallel evolution as it is the view of Mizukubo & Hirashima (1987). (5) Homologies between the left and the right side of the phallomere complex can be recognised in only very few respects. Probably, most of the complex morphology of the phallomeres has evolved when asymmetry had already been established. The concept of side-homologous subregions in Mizukubo & Hirashima (1987) and the assumptions of side-homologies in Grandcolas (1994) are refuted.

Moran, M.D. & Hurd, L.E. (1998) A trophic cascade in a diverse arthropod community caused by a generalist arthropod predator. *Oecologia* (Berlin), **113**(1): 126-132.

We tested the hypothesis that a generalist arthropod predator, *Tenodera sinensis* Saussure, could trigger a trophic cascade in an old-field ecosystem. These mantids had relatively weak effects on abundance and biomass of other carnivorous arthropods as a group. The effect of mantids on herbivores was stronger than on carnivores, mainly concentrated in Homoptera and Diptera. Herbivore load was reduced by mantids with the consequence that overall plant biomass (mainly grasses) was increased. Per capita interaction strengths between mantids and other arthropod taxa were, for the most part, weakly negative. Our study demonstrates that a significant trophic cascade can be triggered by a generalist predator even within the framework of a diverse community with relatively diffuse interactions.